#12

instruction manual

INSTRUCTION MANUAL

VRS-AC-751

VA-28

VOLTAGE REFERENCE SOURCE

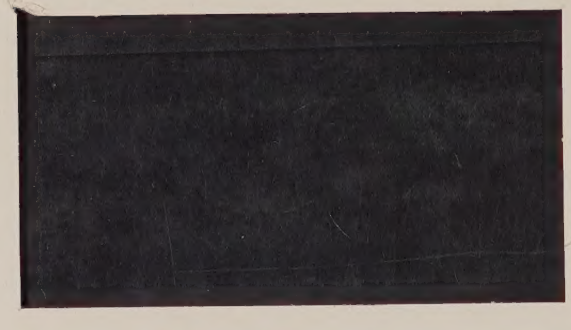
Sorensen & Company, inc.

Richards Avenue

South Norwalk, Conn.

MP MASTER

MA25491



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SORENSEN & COMPANY, INC., 375 Fairfield Ave., Stamford, Conn.

I. GENERAL INFORMATION

Before you begin to use your new Sorensen instrument, we suggest that you read this Instruction Manual very carefully. The information contained herein is designed to help you obtain the maximum in performance and many years of dependable service from your instrument.

A. SHIPPING DAMAGE

The instrument should be inspected and tested immediately upon arrival. In the event the unit fails to operate properly or is damaged in any way, the carrier should be notified at once. When the claim agent has inspected the shipment and prepared a report of damage, a copy of this report should be sent to us. At that time, we will advise you concerning the repair or replacement of the instrument.

B. SERVICE AND INFORMATION

All questions concerning the operation or malfunctioning of this instrument should be directed to the Service Department, Sorensen & Co., Inc., 375 Fairfield Avenue, Stamford, Connecticut.

C. IMPORTANT

BE SURE TO INCLUDE THE MODEL AND SERIAL NUMBERS IN ALL CORRESPONDENCE CONCERNING THIS INSTRUMENT. WITHOUT THIS INFORMATION, WE MAY NOT BE ABLE TO GIVE YOU PROMPT AND ACCURATE SERVICE.

D. IN THE EVENT OF DIFFICULTY

Should you receive a defective or damaged instrument or require service on an instrument within or outside of warranty, please write us. Be sure to include as much information as possible concerning the symptoms of difficulty, the application, input line voltage, etc. The more information you give us, the faster we can handle your request.

In each case, we will decide whether the instrument requiring service will be (a) returned to the factory, (b) shipped to a service station, or (c) serviced at your plant by one of our field engineers or representatives.

If the instrument should be returned to the factory, we will send you shipping instructions in the form of a Returned Material Tag. DO NOT SHIP A UNIT TO THE FACTORY WITHOUT THIS TAG.

E. SHIPMENTS

All shipments to Sorensen should be prepaid unless we authorize to the contrary. The instrument should be wrapped in heavy paper and packed in the original container or a wooden box with at least three inches of shock absorbent material on all sides.

F. WARRANTY

This instrument is warranted by Sorensen & Company, Inc., to be free from defects in material and workmanship. Our obligation to the original purchaser under the warranty is limited to servicing the instrument and replacing defective parts (with the exception of tubes* and fuses) when the instrument is returned to the factory with transportation charges prepaid. No other warranties may be implied.

The period of warranty is one year after the date of delivery of the instrument to the original purchaser.

Defects caused by improper operating conditions, accidents, misuse or negligence and the alteration or removal of the nameplate will void the warranty.

* Thermosen tubes in Sorensen equipment are guaranteed for 5,000 hours or one year, whichever expires first.

II. SPECIFICATIONS

Input Voltage Range	105-125 volts AC single phase
Input Frequency	60 ±.5 cycles
Input Current	7 amperes ma ximum
Output Voltage	0-799.9 volts in 0.1 volt steps
Output Load	240 VA, but not to exceed 5 amperes. IMPORTANT: See section IV, D-3.
Output Voltage Accuracy	0.25% direct reading in 20° - 30°C ambient. (±0.35% below one volt)
Harmonic Distortion (generated by VRS-AC-751)	1% maximum

III. INSTALLATION & OPERATION

A. The VRS-AC-751 will be shipped in TWO parts--(1) the cabinet with the precision transformer, switches, and the 4 leveling screws, [redacted] the AC Voltage Regulator, and (3) the front panel precision voltmeter.

B. Mounting & Assembly

1. Install the four (4) leveling screws in the appropriate threaded holes on the bottom of the instrument's cabinet.

[redacted]

1. The panel precision voltmeter should be mounted by means of the four (4) screws supplied with the meter. This should be done after the front panel is in place.

C. Electrical Connections

CAUTION: DANGEROUS VOLTAGES MAY EXIST IN THIS INSTRUMENT. PLEASE OBSERVE APPROPRIATE PRECAUTIONS.

1. Connect the two leads provided within the cabinet to the precision panel meter. They are connected to (1) the lower left and (2) the "± low" terminals at the rear of the meter. Either lead may be connected to either terminal.
2. The input cord may be then connected to any 115V power output observing the following instructions:

   a. Grounding Precautions:
   The chassis is isolated from the input and output terminals and it is recommended that the chassis and case be grounded for safety reasons. The input power is applied by means of a line cord utilizing a three prong plug. Since the third prong of this plug is connected to the chassis, connection of the line cord to an appropriate receptacle automatically grounds the equipment. If the user does not have three prong outlets available, he should use an adapter. The user should make sure that the extra wire, coded green, coming out from the adapter, is solidly grounded to the power line wiring system. It should be noted that the output terminals will still be isolated from ground, however.

3. Before doing any work on the regulating circuits of the instrument, the line cord should be disconnected even though the "On-Off" switch disconnects both sides of the line.
4. The instrument is protected against overloads by fuses. One fuse limits the output current to 5 amps, while another fuse limits the output to 240 VA. A third fuse protects the regulator against internal control circuit failure, (refer to Section VI).

D. Leveling Procedure

The instrument should now be leveled utilizing the four leveling screws installed on the bottom of the cabinet, and the bubble on the top of the precision voltmeter. Adjust the four screws until the bubble is in the center of the glass, just as one would level a laboratory balance scale.

E. Zero Adjustment of the Precision Voltmeter

1. A zero adjustment screw is provided for the precision voltmeter. It is located on the top of the meter, and may be reached with a screwdriver through the access hole in the top of the cabinet.
2. Before the instrument is first turned on, the meter's pointer should be adjusted by means of this screw to the zero line.

Note: Be sure to do this operation most carefully as accurate adjustment is necessary for calibration. This screw is a very fine adjustment and should be turned with care. When checking the zero alignment, be sure to always read at eye level, similar to checking a thermometers reading.

F. Operating Procedure

1. Turn the instrument by means of the "On-Off" switch on the front panel.
2. After approximately one minute, the needle on the front panel meter will be at center scale. Allow the instrument to warm up for 20-30 minutes. Then reset the output by means of the potentiometer on the front panel (marked Volt Adj) until the pointer is exactly on the red center line. If the output cannot be set properly, additional adjustment can be made by means of the "coarse voltage adjustment" located internally at the rear of the control circuit chassis. This become accessible when the rear door is opened.
3. It may be desirable at this time to turn the instrument off and readjust the meter to zero if necessary.
4. With the decade switches at zero, connect the meter that is to be calibrated to the binding posts at the bottom of the front panel, follow the suggestions in Section IV, D.
5. Set the decade switch to the desired output, readjust output if necessary to recenter the panel meter pointer.

CAUTION: WHEN USING THEROCOUPLE TYPE METERS, USE THE STANDBY SWITCH (S2) BEFORE USING DECADE SWITCH TO AVOID POSSIBLE DAMAGE TO THERMOCOUPLE.

IV. PRINCIPLE OF OPERATION

A. The operation of this instrument can best be understood by referring to the schematic drawing furnished with each instrument. All components shown on the schematic are listed below together with their function in the circuit.

C1 Filter capacitor for V2 plate supply.
C2 Filter capacitor for bridge HV supply.
C5 AC capacitor used to resonate with L1 to the 3rd harmonic of the supply voltage, in order to suppress this harmonic.
C6 Anti-hunt capacitor in feedback network from plate of V2.
C7 AC Capacitor used to resonate with L2 to the 5th harmonic of the supply voltage in order to suppress this harmonic.

F1 Fuse for control circuit power supply of regulator--2 amp (Front Panel)
F2 Output fuse of instrument. Limits output current to 5 amp (Front Panel)
F3 Overload fuse to protect regulator--limits output to 240 VA (Front Panel)
L1 AC reactor--see C5
L2 AC reactor--see C7
P1 Control circuit pilot light (Front Panel)
R1 Resistor (resistance wire cut to size at Final Test), used to compensate the regulation so that effects of input voltage are minimized.

R2 Series limiting resistor in HV bridge supply circuit to limit peak currents in rectifier S1 and capacitor C2.

R3 Anti-hunt resistor in negative feedback circuit from plate of V2.

R4 & R5 Bleeder resistor and voltage divider to supply V2 screen voltage.

R8 Diode adjust resistor (resistance wire cut to size at final test). This resistor centers the output adjustment range of the panel potentiometer R9.

R9 Output voltage fine adjustment potentiometer. (on front panel)

R10 Resistor in plate circuit of V2 used in the feedback network (anti-hunt).

R11 Negative temperature coefficient (N. T. C.) carbon resistor in the V1 diode filament circuit. This resistor aids in reducing output voltage changes caused by ambient temperature changes.

R12 Temperature compensation adjustment resistor (resistance wire cut to size) used to adjust the effect of R11.

R14 Load resistor connected across output to act as minimum load.

R15 Load line resistor (stranded insulated copper wire cut to size at final test). Compensates regulation to minimize the variations in output voltage normally caused by load variations.

R16 Diode V1 plate load resistor.

R20 Swamping resistor across DC coil of reactor T3. This limits high peak voltages across this coil on surges.

R22 Shunt Resistor to Limit Potentiometer R9 Control Range.

R23 Course Output Adj. Potentiometer.

R26 Dummy Load Resistor Connected across instrument's output to act as a minimum load, thus improving operation with small loads.

S1 Selenium rectifier for HV bridge power supply.

S2 Anti-surge selenium rectifier in grid circuit of V2. This device prevents positive-grid operation during regulator warm-up, which could otherwise cause momentary grid-blocking (and high output voltage).

SW1 DPST "on-off" input power switch (Front Panel).

SW4 Fuse By-Pass Switch (Front Panel).

SW5 Stand-By Switch (Front Panel).

SW6 Decade Switch - Calibrated in Units (0-9) (Front Panel).

SW7 Decade Switch - Calibrated in Tens (0-90) (Front Panel).

SW8 Decade Switch - Calibrated in Hundredths (0-700) (Front Panel)

SW9 Decade Switch - Calibrated in Tenths (0-.9) (Front Panel)

T1 Control Circuit Power Transformer

T2 Compensation Transformer, coupling the two compensating voltages (from R1 and R15) into the diode sensing circuit (filament of V1).

T3 Saturable Core Reactor, in power handling circuit.

T4 Auto Transformer, in power handling circuit.

T6 Precision Decade Transformer (High Range).

T7 Precision Decade Transformer (Low Range).

V Calibrated Precision Voltmeter (Front Panel).

V1 Sensing Diode.

V2 Power Amplifier Tube.

V3 Power Rectifier Tube (for V2 Plate Supply).

B. Meter Circuit.

The output of the line regulating circuit feeds a precision wound transformer T6 having essentially two secondary windings. One winding feeds a calibrated voltmeter set for 150 volts AC. This meter is the reference element, and hence determines the basic accuracy of the instrument. The other secondary winding has multiple taps and is fed through a 5 ampere fuse to theoutput terminals. This winding's output voltage, in addition, feeds a second precision transformer which furnishes the 0-.9 volt decade output range (T7).

Note: The regulator does not determine the instrument accuracy, but serves to eliminate line voltage from affecting the meter.

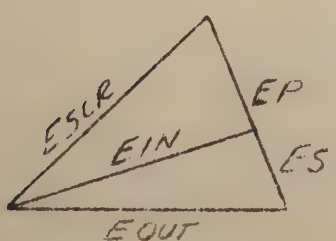
C. Voltage Regulator.

The operation of the regulating circuits can best be understood by referring to the schematic diagram included. The following paragraphs give the essential operation of the regulator and the function of its circuits.

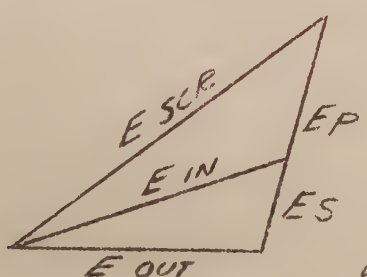
1. Basic Power Circuit.
The basic power circuit includes an autotransformer T4 and a saturable core reactor T3. The reactor is in series with the primary of the autotransformer across the input terminals. Variation of the impedance of the saturable core reactor will vary the voltage impressed on the primary of the autotransformer, and consequently will vary the output voltage. A decrease in reactor impedance, will for instance, increase the portion of the input voltage impressed on the autotransformer primary, and will result in an increase in output voltage. Conversely, an increase in reactor impedance will result in a decrease in output voltage.

The phase relationships of the voltages in the power circuit are illustrated by these Vector diagrams:

Es - Voltage of autotransformer secondary.
Ep - Voltage of autotransformer primary.
Esr - Voltage across saturable core reactor.
Ein - Input voltage.
Eout- Output voltage.



LOW INPUT



HIGH INPUT

2. Electronic Control Circuit.

All that is necessary to achieve voltage regulation is some automatic method of varying the reactor impedance by the right amount to restore the output voltage to its original value at such times as it may vary due to changes in load or input voltage. This action is accomplished by the electronic control circuit.

The basic voltage sensitive element is the Wheatstone Bridge. One arm of the bridge consists of the diode V1, the filament of which is lighted by the output voltage. Only two arms of the bridge show on the schematic diagram. The power supply has the missing two arms by virtue of its arrangement.

The diode is operated at a temperature limited condition. With this arrangement a small increment of output voltage results in a change in cathode emission and a large change of plate resistance in the diode. The signal voltage of the bridge is applied to the grid of beam power tube V2, which controls the DC saturating current of the reactor.

3. Sequence of Operation.

A typical sequence of operation is as follows: Assume a rise in output voltage as a result of reduced load or a rise in input voltage. Increased output voltage results in increased voltage and heating of the diode filament. With increased heating, the diode cathode emission increases reducing the plate resistance of the tube. Since the diode forms an arm of the bridge, a change in plate resistance will change the balance condition of the bridge; in this instance the change results in a more negative potential applied to the grid of V2. The more negative grid signal results in a sharp drop in the plate current of V2, consequently, reduced saturation of the reactor. Reduced DC saturation of the reactor results in an increase in AC impedance which, as pointed out before, lowers the output voltage.

The above action will continue until an equilibrium is reached wherein the net change in output voltage is sufficient to compensate for the changed circuit conditions in the control circuit. The gain of the control system is of such magnitude that the unit will maintain output voltage within tolerance rated, while compensating for the rated range of input voltage and load variations.

4. Rectifiers.

The tube V3 is a rectifier tube for the saturating circuit, and S1 a selenium rectifier for the diode bridge circuit.

5. Output Voltage Adjustment.

Adjustment of the output voltage is accomplished by the potentiometer in the circuit supplying the diode filament voltage. Variation of the resistance in this circuit varies the value of output voltage required to obtain a given diode filament temperature, and consequently, will control the output voltage.

6. Swamping Resistor.

The resistor R20 shown connected across the control coil of T3 is a swamping resistor to absorb inductive surges originating in the DC reactor winding.

Note: When the regulator is first turned on, electronic circuit elements are cold and a period of approximately 60 seconds is required for the unit to reach operating temperature. During this period the output voltage will be low; however, as the tubes begin to conduct, the output voltage rapidly rises to its proper adjusted value. This is a normal condition and in no way indicates any malfunctioning of the Regulator.

D. Accuracy of the Instrument.

The .25% over-all accuracy of this instrument is determined by many factors. The important ones are described in the following paragraphs. Much greater accuracies are possible by correcting the dial readings for transformer ratio error, and loading error (Appendix A & B). Caution should be used in applying the loading error curves, however, as they are only approximately correct, and actual values may vary ± 20% from unit to unit.

1. Reference Meter Accuracy.

The front panel meter has been carefully calibrated to within ± 0.1%. It is well compensated for warm-up and ambient temperature changes. To insure maximum accuracy, however, the instrument should be allowed to warm up for 20-30 minutes. Change in meter calibration due to temperature changes following this warm-up period will be less than ± .05%.

Note: If the instrument is used without sufficient warm-up, then the output voltage error contributed by the meter may be as large as 0.20%. This error will decrease to the calibration accuracy of 0.10% as the instrument warms up completely.

2. Transformer Ratio Accuracy.

The transformer ratios between any output winding and the 150V meter winding is held to 0.1%. The exact ratio of any winding (to ± .01% accuracy) for each instrument is included in Appendix A of this manual.

3. Loading Error.

If the load is sufficiently large, the front panel meter will be displaced from the calibration marker. Therefore, before making any final readings, the needle should be carefully reset to the red line to eliminate this error.

The output impedance of the instrument is very low but finite; consequently, there will be a voltage drop which must be taken into account. A curve showing the maximum current that can be drawn from the equipment to hold this loading error to 0.1% is supplied with each unit (Appendix B).

4. Fuse By-pass to Reduce Internal Impedance.

At low output voltages (especially below 10.0 volts) the 5 amp protective fuse contributes very heavily to this internal drop and therefore a fuse by-pass switch (momentary-on) is incorporated in the equipment. Depressing this switch (SW1) will short out this fuse.

CAUTION: This switch should be depressed only when a final reading is to be made since it eliminates protective devices.

5. Unfused Output.

For additional reduction of internal impedance in the 0-9.9 volt range, a separate unfused output is available on the front panel. The loading curve in Appendix B of this manual (0-9.9 volt range) is for this low impedance output. Since this output is unfused, it is advisable to check the meter under test on the 10-799.9 volt output terminals first, and then switch over to the low impedance terminals.

6. High Currents.

If currents higher than those given on the loading curve are to be drawn from the instrument, the loading error will be increased proportionately (e.g., doubling the current given will increase the loading error to -.2%).

At output voltages above 300 volts, arcing at the switch contacts may occur during switching operations. There is incorporated a standby switch (SW2) on the front panel which disconnects the output. Before changing any range switch (except 0.1-0.9 range switch) when the output voltage is above 300 volts, this standby switch should be turned off. After the range switching operation has been made, the switch may be turned on.

V. MAINTENANCE AND REPAIR

"During normal life, the unit requires no maintenance or servicing other than the care usually afforded this type of equipment. Vacuum tubes should be replaced at the end of their specified life in accordance with the policies established for the particular application. Since the life of rectifier stacks and other electrical components can be considerably reduced by restricting the air flow around them, it is suggested that excessive dust, etc., be removed periodically. At such time care should be exercised to prevent damage to the equipment by cleaning tools or excessively strong air blasts."

A. SPARE PARTS

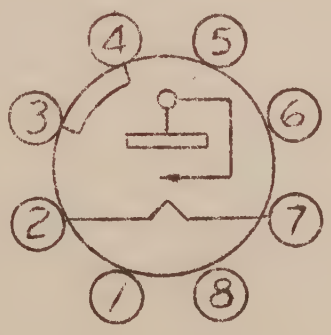
All components in Sorensen Regulators are of a good commercial grade and can be expected to give a reasonably long period of trouble-free service. As the age of the instrument increases, however, some components are likely to deteriorate; we therefore suggest that the customer keep on hand the spare parts as indicated by an asterisk on the Parts List supplied with the unit.

In the event it becomes necessary to replace any part, we strongly suggest that the replacement parts be of the same value as the original. Substitute parts should not be used unless we advise that the substitute part will not impair the performance of the instrument.

B. 2AS15A TUBE DATA

In almost all cases, it will be found that if the 2AS15A filament is intact the tube is good; however, for those customers who wish to set up special tests, the following data is included:

Filament	1.8 volts DC/AC 310 - 335 ma.
Plate	500 volts DC .410 - .600 ma. DC



C. COMPENSATION PROCEDURE.

The Regulator has several components that are factory adjusted to the optimum value and readjustment in the field is not recommended. However, a brief description of the procedure is given to be used in an emergency. As noted on the schematic, R1 is a resistor consisting of a suitable length of nichrome wire. This value is pre-set at the factory.

In general, increasing the value of this resistance will produce an effect of causing the output voltage rise to be less than normal and even decrease when the line voltage is increased. Several trials should produce the optimum value. Although load compensation is primarily determined by the "load line," adjustment of R1 also has some effect on load compensation. Load compensation is obtained by inserting the optimum value of resistance of the conducting lead between the output terminal or point where the other primary terminal of T2 connects to the output line. This is designated as the "load line" on the schematic. One terminal of the primary of T2 is connected to R1. For special conditions under or over compensation can be achieved to cause the same effect for load changes. This latter characteristic is handy when voltage drop in long leads must be accounted for.

Another adjustment involves the resistor designated R8. Adjustment of this resistor may be necessary when a new diode is installed and the voltage adjustment potentiometer does not permit setting the output voltage at 120 volts.

Adjustment of R12 is made to secure optimum temperature compensation. This should not be adjusted since the optimum value cannot readily be determined in the field. However, in an emergency the value of this should be such that the output voltage drops 6 to 8 volts when the trial value of R12 is shorted out under full load.

D. TROUBLE SHOOTING & REPAIR.

In the event of malfunctioning of the unit due to deterioration or failure of any of its component parts, a systematic checking procedure will provide the quickest and surest method of locating the difficulty. The following section gives systematic checking procedures which should be followed in locating sources of trouble. It should be remembered, however, that the personnel doing the trouble shooting should be familiar with electronic equipment in order not to cause additional trouble or damage to the instrument.

The schematic enclosed with this Manual shows the voltages which should exist in various parts of the circuit during normal operation. These voltages should be measured with an electronic type voltmeter. Note that the input voltage and load must be approximately as stated on the schematic to check these voltages.

DANGEROUS VOLTAGES EXIST IN THE CONTROL CIRCUITS. OBSERVE APPROPRIATE PRECAUTIONS.

TO PREVENT DAMAGE TO THE PRECISION METER WHILE TROUBLE SHOOTING, THE LEADS TO THE METER SHOULD BE REMOVED.

1. The first step in trouble shooting should be to replace tubes. In most cases, this is enough to cure the trouble.

2. Problem A--No Output Voltage.

   This condition indicates an open in the power circuit.

   Procedure:

   a. Check that the "on-off" control is in the "on" position.

   b. If the front panel meter reads properly, the 5 ampere fuse on the front panel is blown or there is an open in the decade switch assembly.

   c. If the front panel meter does not read and the pilot light is on, the 3 ampere fuse (F3) located on the bottom right hand corner is probably blown. If not, the precision decade transformer is either open or not receiving power from the regulating circuits.

   d. If the meter does not read and the pilot light is out, the regulating circuits are defective. Check the autotransformer, AC reactor coils, circuit breaker, power leads and terminals for continuity.

3. Problem B--The Front Panel Meter Indicates no Regulation and Low Output Voltage with Load.

   This condition indicates the failure of the electronic control circuit to supply saturating current.

   Procedure:

   a. Check the fuse in the control circuit. This is the 2 ampere fuse located to the left of the pilot light.

   b. Inspect tube filaments to see that they are lit.

   c. Check tubes in a tube tester or by replacement with tubes known to be good.

   d. Check the DC power supply. No voltage will indicate a failure of the transformer winding or of the filter condenser. Check rectifier tube.

   e. Check the plate voltage and grid voltage of the beam power tube V2. If the grid voltage is abnormally negative and causing cut-off, check the diode bridge supply voltage and the diode filament supply voltage.

   f. Check the DC reactor winding for an open.

4. Problem C--If the Output Voltage is High and there Appears to be no Regulation.

Procedure:

a. Check to see that the diode filament is lighted.

b. Check tube V2 in a tube tester or replace with a spare that is known to be good.

c. Remove V2. If output voltage drops, difficulty is in the control circuit.

Check V2 grid voltage to cathode to ground.

If this voltage is abnormally positive or zero, check contacts, connections and resistance values of all components of the bridge. Check diode or replace with a spare known to be good. Check bridge rectifier.

d. Check the voltage adjusting potentiometer for dirty contacts.

5. Problem D--The Range of Voltage Adjustment is such that the Front Panel Meter cannot be set Properly.

This condition indicates a variation of tube characteristics with age.

a. Check tubes or replace with spares known to be good.

6. Problem E--Reduction of Regulating Range or Poor Regulation in General.

These conditions may be the result of deterioration or failure of various components of the control circuit.

a. Check tubes or replace with spares.

b. Check the DC power supply voltages.

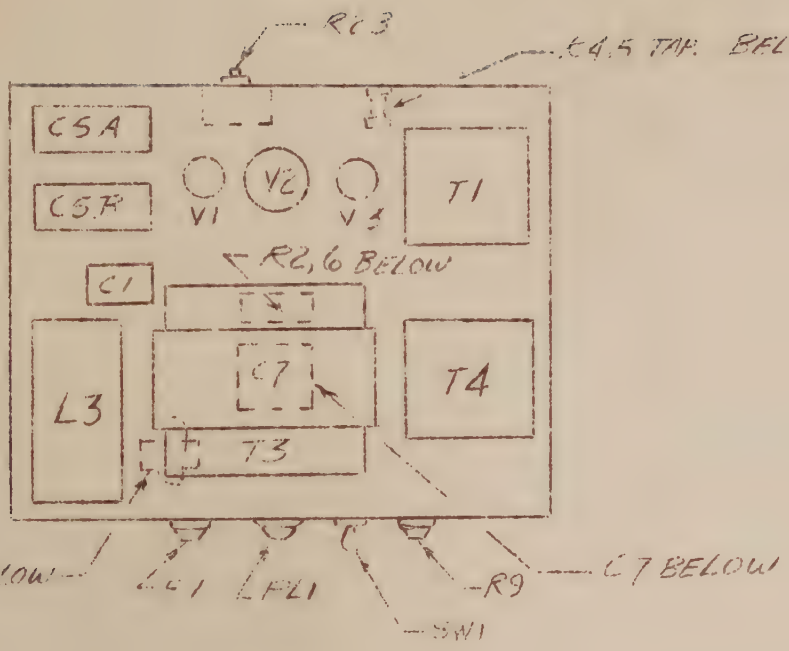
c. Check the control circuit in general for loose connections, shorts or damaged parts.

d. Check voltage and resistance values. Check condensers by replacement.

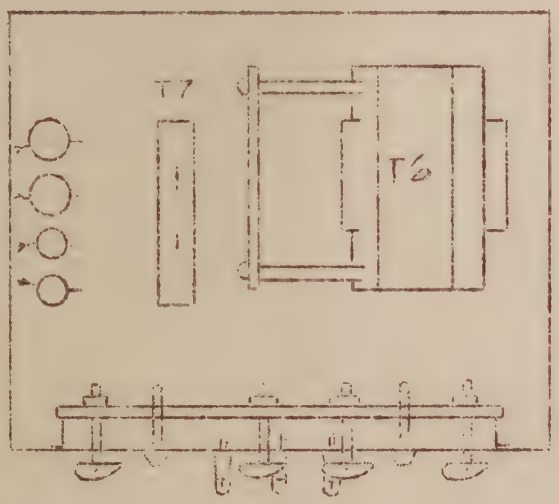
e. The output voltage adjustable potentiometer may cause irregular output adjustment. Turn the potentiometer shaft several times in both directions as far as it will go. This is a very low resistance adjustment and contacts can oxidize enough to cause uneven control.

IN THE EVENT OF SERIOUS TROUBLE OR DAMAGE TO THE UNIT, RETURN IT TO THE FACTORY FOR REPAIR AND READJUSTMENT.

TOP VIEW OF REG. SECTION

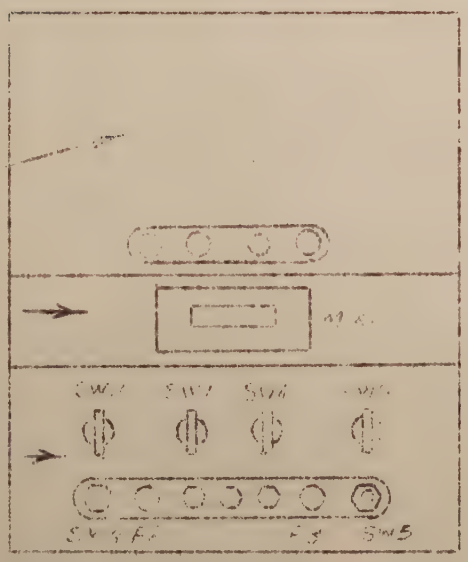


TOP VIEW OF UNIT BASE



MODEL
VRS-AC-751

FRONT VIEW OF THE ENTIRE UNIT



APPENDIX A

TRANSFORMER RATIO ERROR CHART

Serial No. VA-28

OUTPUT VOLTS	ERROR	OUTPUT VOLTS	ERRORS
.1 - .9	-.02 ± .03%	40	0 %
1	-.04	50	+.01
2	0	60	+.01
3	-.03	70	+.01
4	0	80	+.01
5	-.01	90	+.01
6	-.01	100	-.05
7	-.01	200	-.05
8	-.01	300	-.04
9	-.02	400	-.04
10	0	500	-.03
20	0	600	-.03
30	+.02	700	-.02

As an example for determining ratio error (values given are not necessarily correct for this unit):

1. Determine ratio error at a setting of 247 volts.

   a. At 200V, error is -.03%

   200 X -.03 = -6.00

   b. At 40V, error is -.08%

   40 X -.08 = -3.20

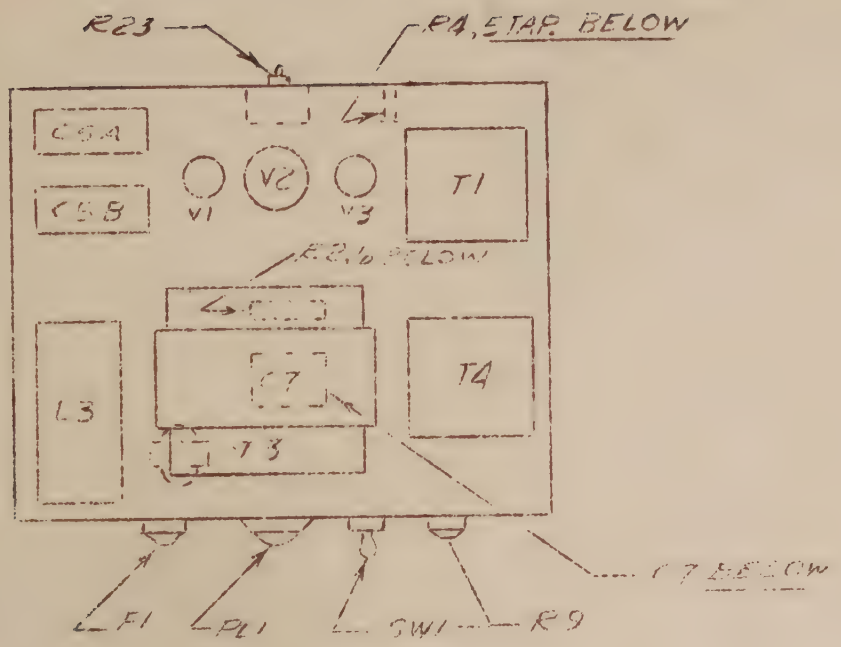
   c. At 7V, error is -.08

   7 X -.08 = -.56

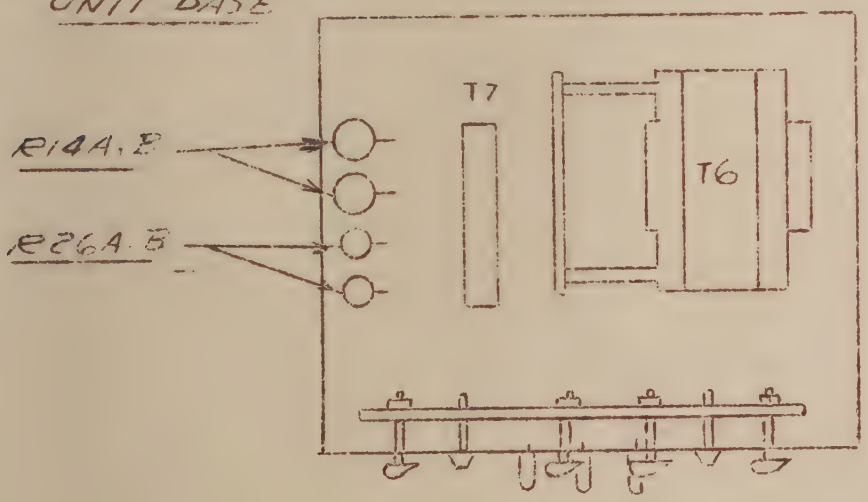
   Total -9.76

   error = $\frac{-9.76}{247}$ = -.04%

TOP VIEW OF REG. SECTION

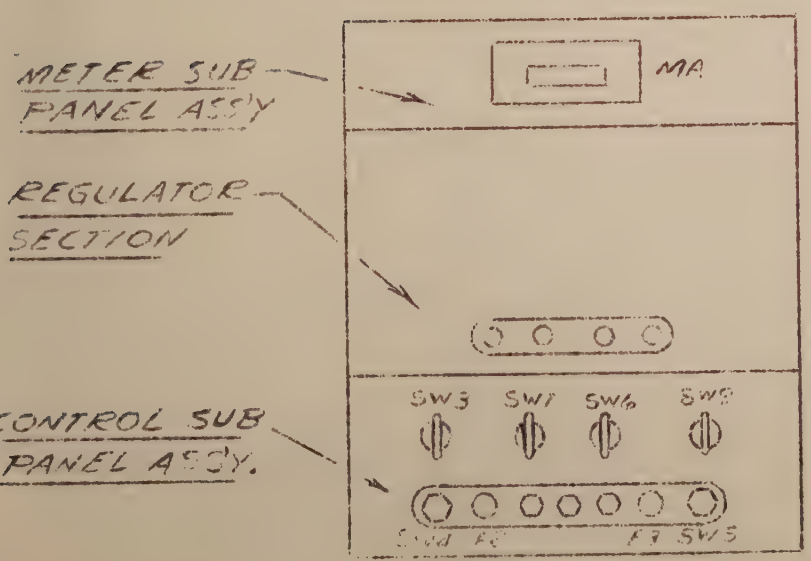


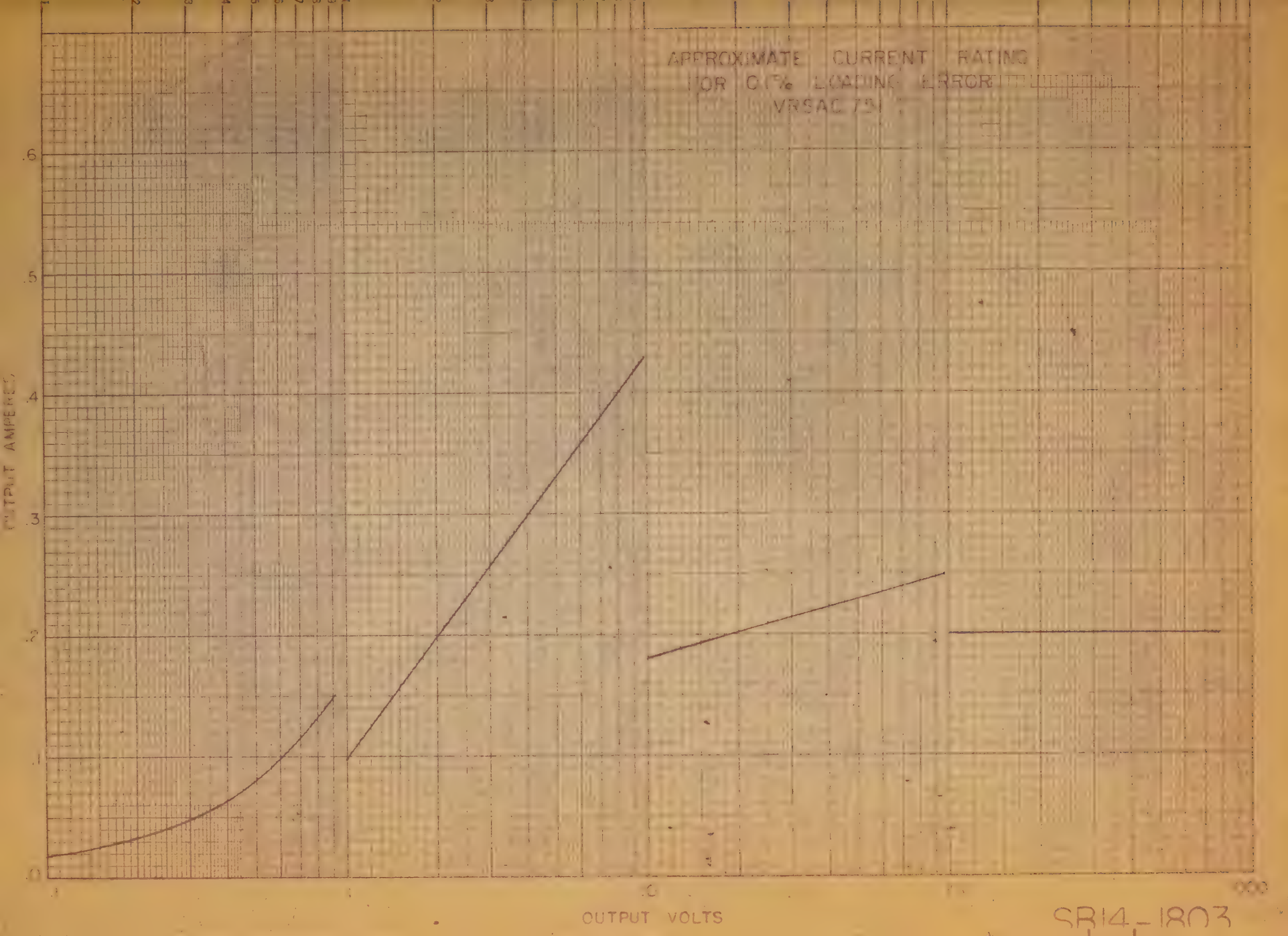
TOP VIEW OF UNIT BASE



MODEL VRS-AC-751

FRONT VIEW OF THE ENTIRE UNIT




APPROXIMATE CURRENT RATING
FOR 0.1% LOADING ERROR
VRSAC 75
.6
.5
.4
.3
.2
.1
0
OUTPUT AMPERES
OUTPUT VOLTS
SB14-1803

SORENSEN & COMPANY, INC., 375 Fairfield Avenue, Stamford, Conn. SB14-1792

REPLACEMENT PARTS LIST

Model VRS AC 751

Serial No. ~~VRS~~ VA-1 to

ic	Description	Sorensen Part No.	Specifications
12	Resistor Comp. & Diode Adj.	190-632	Sorensen & Co., Inc.
	Resistor 10K 1/2W	27-133	Allen Bradley EB1031
0	Resistor 27K 2W	27-309	Allen Bradley HB2731
	Resistor 35K Tapped at 10K	90-071	Sorensen & Co., Inc.
	Pot 0.1 ohm 3W.	29-074	Per Sorensen Spec. SB14-1431
	Resistor N.T.C. 2.6 ohms	27-925	Sorensen & Co., Inc.
-B	Resistor 500 ohms 50W	27-816	Ward Leonard 50F
	Resistor Load Line 6"-24"	21-3019	#18 Std. Copper-Wire
25	Resistor 1.8 Meg. ohms 1W	27-253	Allen Bradley GB1851
	Resistor 15K ohms 1W	27-264	Allen Bradley GB1531
	Resistor .24 ohms 1/2W	27-968	IRC BW 1/2
	Pot. 0.1 ohm 3W	29-010	Per Sorensen Spec. SB14-967
-B	Resistor 25K ohms 10W	27-529	Ward Leonard 10F
	Capacitor 4 mfd. 600 VDC	24-308	Sprague C 030-24
6	Capacitor 2Xo.1 mfd 1500 VDC	24-232	Aerovox P30J10
8	Capacitor 7 mfd 330 VAC	24-301	Sprague P50857
	Capacitor 2 mfd 330 VAC	24-236	Per Sorensen Spec. SB14-1353
2*	5th Harm. Choke & Power Trans.	127-783	Sorensen & Co., Inc.
	Comp., Trans.	126-815	Sorensen & Co., Inc.
	Sat. Core Reactor	127-697	Sorensen & Co., Inc.
	Auto Trans.	126-1453	Sorensen & Co., Inc.
	Precision Decade Trans.	126-1514	Sorensen & Co., Inc.
	Low Range Decade Trans.	126-1612	Sorensen & Co., Inc.
3	3rd Harm. & Load Choke	127-1084	Sorensen & Co., Inc.
	Selenium Rectifier	26-900	Per Sorensen Spec. SB14-1441
rnate	Selenium Rectifier	26-947	Bradley Lab., Inc. #SE7L36H438
	Selenium Rectifier	26-904	Per Sorensen Spec. SB14-1399
(2ea*)	Tube 2AS15A	12-010	Thermosen Inc.
(*2ea)	Tube 6L6GB	12-032	Commercial
(*2ea)	Tube 5Y3GT	12-023	Commercial

eference see
natic drawing
D200-1185
See Serial No

* RECOMMENDED SPARE PARTS: This instrument normally requires the replacement only of tubes, pilot lamps, etc. However because of possible improper use, and because of the effects of high ambients and of certain kinds of tube failures (and of protective devices) we suggest that the parts marked with an asterisk be kept on hand. PLEASE REFERENCE THE MODEL AND SERIAL NUMBERS ON ALL PARTS ORDERS.

List No. SB14-1792
Page 1 of 2
Prepared by D.J.
Date 1/8/57 1-9-57

SORENSEN & COMPANY, INC., 375 Fairfield Avenue, Stamford, Conn. SB14-1792

REPLACEMENT PARTS LIST

Model VRS AC 751

Serial No. [redacted] VA-1 to

tic	Description	Sorensen Part No.	Specifications
	DPST Switch	45-112	Cutler Hammer 7561K5
	SP Toggle Switch	45-132	Cutler Hammer (8817K5)
	DPST Switch	45-131	Arrow-Hart & Hegeman Co. 81831-U
7,9	Decade Switch	45-211	Per Sorensen Spec. SB14-1531
	Decade Switch	45-212	Per Sorensen Spec. SB14-1530
*3ea)	Fuse 2amp 3AG 250V	42-408	Littelfuse 312002
*3ea)	Fuse 5amp 3AG 250V	42-413	Littelfuse 312005
*3ea)	Fuse 3amp 3AG 250V	42-409	Littelfuse 312003
	Fuse Holder	42-460	Littelfuse 342001
(*2ea)	Pilot Lamp 6-8V .15 amp	42-303	GE #47
	Dynometer Voltmeter	94-251	Per Sorensen Specs. SB14-1518 & SC14-1534

eference see
natic drawing
00-1185
See Serial No.

* RECOMMENDED SPARE PARTS: This instrument normally requires the replacement only of tubes, pilot lamps, etc. However because of possible improper use, and because of the effects of high ambients and of certain kinds of tube failures (and of protective devices) we suggest that the parts marked with an asterisk be kept on hand. PLEASE REFERENCE THE MODEL AND SERIAL NUMBERS ON ALL PARTS ORDERS.

List No. SB14-1792
Page 2 of 2
Prepared by D.J.
Date 1/8/57 1-8-57

ONTROLLED POWER FOR RESEARCH AND INDUSTRY

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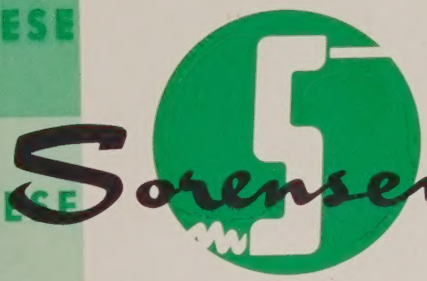


AC

ELECTRONIC REGULATORS

·

MAGNETIC VOLTAGE REGULATORS

·

400 CYCLE REGULATORS

·

TUBELESS REGULATORS

·

FREQUENCY CHANGERS

·

VOLTAGE REFERENCE SOURCES

DC

LOW VOLTAGE HIGH CURRENT

·

HIGH VOLTAGE LOW CURRENT

·

WIDE RANGE, ADJUSTABLE OUTPUT

·

TUBELESS REGULATED SOURCES

·

TRANSISTOR POWER SUPPLIES

·

400 CYCLE POWER SUPPLIES

CONDENSED STANDARD SPECIFICATIONS

SORENSEN & COMPANY, INC., • SOUTH NORWALK • CONN.

CONTROLLED POWER FOR RESEARCH AND INDUSTRY

FREQUENCY FLEXIBILITY

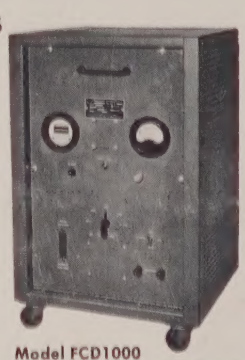
Sorensen electronic frequency changers convert 50 or 60 cycle line to well-regulated AC output at 60 cycles, 400 cycles, or a wide range of output frequencies. These convenient, portable sources have found general application in aviation, missile, automatic control and related fields.

1000VA FREQUENCY CHANGERS

Model FC 1000 (45-65 cps out.)
Model FCD 1000 (360-440 cps out.)

ELECTRICAL CHARACTERISTICS

Input	208 or 230 VAC ±10% 1ø, 50 or 60 cycles
Output voltage	115 VAC, adj. 105-125V
Voltage regulation	±1%
Output frequency	(FCD 1000) 360-440 cps (FC 1000) 45-65 cps
Regulation accuracy	±1% (±0.01% with auxiliary frequency standard fixed at 50, 60 or 400 cps.)
Load range	0-1000 VA



Model FCD1000

WIDE RANGE FREQUENCY CHANGERS

Model FCR250

Latest, most versatile additions to the Sorensen line of regulated electronic frequency changers. Operating from 50 or 60 cycle line, these voltage- and frequency-regulated units permit simple dial selection of any frequency within a wide output range. Portable and practical, these instruments offer unique solutions to a wide variety of your laboratory, test, or production requirements.

	FCR100	FCR250
Input	105-125VAC, 1 phase, 45-65 cps	105-125VAC, 1 phase, 48-65 cps
Output voltage	115VAC, adj. 0-130V (specs below for 105-125V)	115VAC, adj. 105-125V
Output frequency		
Range 1	45-300 cps	320-570 cps
Range 2	300-2000 cps	560-1000 cps
Voltage Regulation	±1% for line ±1% for load	±1% for all variations
Frequency Regulation	±1% (provision for ext. freq. standard of greater precision.)	±1% (±0.01% with aux. freq. standard fixed at 400 cycles.)
Load range	0-100 VA	0-250 VA (up to 500 watts with improved reg. at 400 and 800 cps)

CONTACT THESE LOCAL REPRESENTATIVES

Whatever your power control requirements—for industry, military applications or research—you will find a unit which meets your *exact* specifications in Sorensen's wide variety of instruments, coupled with the extensive line of high-voltage equipment produced by the Beta Electric Division. In addition to their many standard products, both Sorensen and Beta have unusual experience in the engineering and production of special equipment to meet unique requirements. The authorized local representatives listed below are at your service; call the one nearest you for advice on Sorensen or Beta equipment.

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McCarthy Associates
441 W. California Ave.
Phone Davenport 5-6136

CALIFORNIA—Pasadena
McCarthy Associates*
1055 E. Walnut
Phone Sycamore 2-8272

CALIFORNIA—San Diego 1
McCarthy Associates
934 West Laurel St.
Phone Belmont 9-4015

COLORADO—Denver 10
Lahana & Company
1886 South Broadway
Phone Pearl 3-3791 TWX DN676

CONNECTICUT—Bridgeport
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D. C.—Washington 9
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Phone Decatur 2-5705 TWX WA559U

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Phone Hopkins 7-2290

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Complete service facilities maintained for rapid local servicing of Sorensen and Beta equipment.
†*Sorensen line only.*
††*Beta line only.*

MP MASTER
MA25491

ITE FOR LITERATURE

Send for complete information, including specifications, performance data and quotations. Product data sheets are issued on all new units as they become available. Inquiries regarding special applications and specifications are invited. Address Sales Engineering Department, Sorensen & Co., Inc., Richards Ave., South Norwalk, Conn., or (for high voltage applications) write Beta Electric Division, 333 East 103rd Street, New York 29, New York; or contact the local representative shown above. In Europe, please contact directly Sorensen-Ardag, Eichstrasse 29, Zurich 3, Switzerland.

West Coast Field Office: 1055 East Walnut St., Pasadena, Calif.

Sorensen

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PHONE: TEMPLE 8-6571

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